

Social determinants of syphilis in South China: the effect of sibling position on syphilis and sexual risk behaviours

Joseph D Tucker,^{1,2,3} Darwin Young,² Ligang Yang,³ Bin Yang,³ Adaora A Adimora²

To cite: Tucker JD, Young D, Yang L, *et al.* Social determinants of syphilis in South China: the effect of sibling position on syphilis and sexual risk behaviours. *BMJ Open* 2013;**3**:e002834. doi:10.1136/bmjopen-2013-002834

► Prepublication history for this paper is available online. To view these files please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2013-002834>).

Received 5 March 2013
Accepted 29 April 2013

This final article is available for use under the terms of the Creative Commons Attribution Non-Commercial 2.0 Licence; see <http://bmjopen.bmj.com>

¹University of North Carolina Project, Guangzhou, China
²Division of Infectious Diseases, School of Medicine, UNC Chapel Hill, Chapel Hill, USA

³Guangdong Provincial STD Control Center, Guangzhou, China

Correspondence to

Dr Joseph D Tucker;
jdttucker@med.unc.edu

ABSTRACT

Objective: This study evaluated the relationship between sibling position and sexual risk based on behavioural and syphilis infection data from sexually transmitted infection (STI) patients in South China.

Design: A cross-sectional study examining sexual behaviours and syphilis infection.

Setting: 4 STI clinics in the Pearl River Delta of South China.

Participants: 1792 Chinese men and women attending STI clinics.

Primary outcome measures: STI history, syphilis infection defined as positive non-treponemal and treponemal tests.

Results: Among all clinic patients, 824 (46.3%) were first-born, 354 (19.9%) were middle-born and 602 (33.8%) were final-born. Middle-born individuals had a higher percentage of reported STI history (44.7% compared to 34.7%, $p<0.001$) and syphilis infection (9.7% compared to 4.9%, $p=0.01$) among men ($n=1163$) compared to other sibling positions in bivariate analyses, but not in the final multivariate model. The relationship between sibling position and syphilis was independent of income and education level. There was no trend observed between middle-born position and female sexual risk behaviours ($n=626$). Higher education was significantly associated with syphilis among women and men in respective multivariate models.

Conclusions: This study suggests that middle-born men in China may have an increased sexual risk compared to other sibling positions. As Chinese family and social structures change, a more thorough understanding of how demographic factors influence sexual risk behaviours is needed.

INTRODUCTION

Syphilis has made a marked resurgence across China,^{1 2} raising questions about social, economic and other contextual factors that may contribute to transmission. Social determinants that likely drive onward

ARTICLE SUMMARY

Article focus

- Understanding the social and family changes that influence sexual risk behaviours is critical for designing effective sexually transmitted disease control responses.
- Few studies have examined the influence of sibling position on sexual risk behaviours.

Key messages

- Middle-born South Chinese men have an increased sexual risk compared to other sibship positions and this trend is not observed in women.
- The relationship between sibling position and sexual risk was not related to homosexual behaviour, income or education.
- Demographic changes in China related to family norms may have important implications for persistent syphilis transmission.

Strengths and limitations of this study

- This was a relatively large study in a region with an expanding syphilis epidemic, using biomarker and behavioural endpoints.
- More detailed information about sibling relationships was not collected as part of this research.

syphilis transmission³ include gender inequality,⁴ poverty,⁵ sex ratios⁶ and changing family structure.⁷ Dynamic family structures in China could influence syphilis transmission through a number of distinct mechanisms. Increases in the number of poor, uneducated men who are unable to find brides ('surplus men') could lead to an increased demand for unsafe sex.⁸ Rises in divorce could also contribute to the expansion of syphilis.⁷ In recent years, the easing of China's One-Child Policy has created more families with multisibling families.⁹

There are several potential mechanisms whereby sibling position (or birth order)

could directly or indirectly contribute to increased sexual risk behaviours. Later-born siblings receive less parental investment and consequently have less education,^{10–12} less income^{13 14} and worse health^{15 16} compared to their earlier-born counterparts. The trend towards lower socioeconomic status could increase sexual risk behaviours among later-born siblings. Studies among American adolescents have suggested that later-born siblings have increased sexual risk behaviours,^{17–19} but there have not been similar research studies among adults. Men with older brothers have a substantially higher chance of being homosexual,^{20–22} another potential mechanism linking sibling position and sexual behaviours.

Given rapid changes in Chinese family structure and social dynamics, understanding the influence of demographic variables such as sibling position on sexual risk behaviours is important. The purpose of this study was to examine the effect of sibling position on history of sexually transmitted infections (STIs) and syphilis among a sample of clinic patients in South China.

METHODS

This study recruited STI outpatients in China as part of the larger Plum Blossom Study which has been previously described.²³ Briefly, public STI clinics in four sites of the Pearl River Delta region of Guangdong Province were selected using a probability proportional-to-size sampling method.²³ All clinic patients were invited to participate and information about those who refused to participate was also collected.

A written survey for public STI outpatients was field tested among 12 patients in one of the cities. The survey had 58 items, with most items coming from the China Health and Family Life Survey, a population-representative study of sexual behaviours in China.²⁴ The survey included domains on sociodemographic information, sexual behaviours and sibling position. STI history was a dichotomised variable based on asking about the history of each of the following infections: syphilis, gonorrhoea, chlamydia, condyloma acuminata, non-gonococcal urethritis/cervicitis, genital herpes or another STI. The sibling position question asked about the total number of younger brothers, younger sisters, older brothers and older sisters in their family. An only child would be coded '0–0–0–0' since they have zero of each of these types of siblings.

From September 2009 until January 2010, potential study subjects were recruited by physicians and nurses at selected STI clinics. All clinic patients older than 17 years were eligible for participation, regardless of their interest in receiving syphilis testing. Potential participants were referred to a separate, quiet room to speak with a research assistant about joining the study. Participation in the survey was voluntary and no incentives were given to patients to participate in the study. Those who agreed to participate in the study were given

STI counselling after providing verbal informed consent to a trained research assistant. Clinic patients were offered testing and then entered the study.

All participants had approximately 5 ml of venous blood taken for treponemal syphilis testing. All samples had subsequent nontreponemal confirmation and those with syphilis infection received treatment according to standard guidelines.

The primary outcome of the study was having a positive treponemal syphilis serology. Missing values accounted for less than 10% of all the respective independent variables. Occupation was dichotomised into entertainment and non-entertainment based on earlier work supporting higher sexual risk behaviours at entertainment establishments.²⁵ First-borns were categorised as being either the eldest or only children. Middle-borns had at least one elder sibling and one younger sibling. Final-borns included those with at least one older sibling and no younger siblings. These three categories were based on sociology and psychology literature^{26 27} suggesting that sibling positions influence behaviours, including sexual behaviours. Multicollinearity was assessed by calculating the variance inflation factor (VIF) and excluding factors with a VIF over 5. Bivariate relationships were analysed, and unadjusted ORs with 95% CIs were reported. Bivariate relationships were calculated for all participants, only men and only women. Multivariate logistic regression models for men and women were developed by taking all bivariate relationships found to be associated with syphilis infection with $p < 0.10$.

This research protocol and the consent procedure were approved by the Medical Ethics Committee of Chinese Academy of Medical Sciences Institute of Dermatology (Nanjing, China), the University of North Carolina Institutional Review Board (Chapel Hill, North Carolina, USA) and the Partners Committee on Human Subjects Research (Boston, Massachusetts, USA).

RESULTS

A total of 1792 eligible individuals (consenting clinic patients older than 17 years) participated in this study. This included 1163 men and 626 women. Details of the 271 (13.1%) individuals who refused to participate have been described elsewhere.²³ Most clinic patients were 40 years old or younger, men, unmarried, had an annual income of equal to or less than US\$3700, had education less than or equal to high school and were not working in the entertainment industry (table 1). Among all clinic patients, 824 (46.3%) were first-born, 354 (19.9%) were middle-born and 602 (33.8%) were final-born. Among the first-born individuals, 187 were only children and 655 had siblings. HIV risk behaviours are reported in table 2. 721 (40.3%) of individuals reported having a history of a STI.

Among the 1792 participants, 1280 (71.4%) had never been tested for syphilis infection in the past. A total of

Table 1 Sociodemographic correlates and bivariate relationships with syphilis among all clinic patients (n=1792)

Sociodemographic variables	N (%)	Number of positive for syphilis (%)	Unadjusted OR (95% CI)
Sibling position			
First-born	824 (46.3)	57 (3.4)	1
Middle-born	354 (19.9)	40 (12.0)	1.72 (1.24 to 2.63)
Final-born	602 (33.8)	41 (7.1)	0.98 (0.64 to 1.47)
Age			
>40 years	412 (23.0)	41 (10.5)	1
≤40 years	1380 (77.0)	98 (7.5)	0.69 (0.47 to 1.01)
Sex			
Male	1163 (65.0)	63 (5.8)	1
Female	626 (35.0)	76 (12.6)	2.36 (1.67 to 3.35)
Marital status			
Married	624 (37.9)	29 (4.7)	1
Unmarried	1021 (62.1)	105 (10.3)	2.35 (1.54 to 3.60)
Annual income			
≤US\$3700	882 (57.5)	79 (9.0)	1
>US\$3700	651 (42.5)	42 (6.5)	0.70 (0.48 to 1.03)
Education completed			
≤High school	1054 (62.8)	70 (6.6)	1
>High school	625 (37.2)	66 (10.6)	1.66 (1.17 to 2.36)
Site			
Site A	355 (20.9)	36 (10.1)	1
Site B	453 (26.7)	34 (7.5)	0.72 (0.44 to 1.18)
Site C	608 (35.8)	58 (9.5)	0.93 (0.60 to 1.45)
Site D	283 (16.7)	11 (3.9)	0.36 (0.18 to 0.72)
Occupation			
Entertainment	69 (4.1)	7 (10.1)	1
Non-entertainment	1604 (95.88)	129 (8.0)	0.78 (0.35 to 1.73)

1705 (95.1%) of patients were willing to be tested for syphilis infection and 1702 (95%) accepted testing. A total of 139 (7.8%) of individuals had a positive syphilis test. Most clinic patients (1037, 63.6%) reported not using a condom during the last episode of sex with their non-primary sex partner. Relatively few clinic patients reported a history of injecting drug use or same-sex behaviour (table 2).

Among all clinic patients (n=1792), the following factors were significantly associated with syphilis in univariate analyses: middle-born (OR 1.72, 95% CI 1.24 to 2.63) compared to being first-born or final-born; women (OR 2.36, 95% CI 1.67 to 3.35) compared to men; unmarried (OR 2.35, 95% CI 1.54 to 3.60) compared to married; education greater than high school (OR 1.66, 95% CI 1.17 to 2.36) compared to high school or less

Table 2 HIV risk behaviours among all clinic patients (n=1792)

Risk behaviours	N (%)	Number of positive for syphilis (%)	Unadjusted OR (95% CI)
Condom use for non-primary partner*			
Yes	593 (36.4)	43 (7.3)	1
No	1037 (63.6)	92 (8.8)	1.25 (0.85 to 1.82)
Ever engaged in commercial sex			
No	1137 (70.8)	24 (5.1)	1
Yes	468 (29.2)	103 (9.1)	1.81 (1.16 to 2.94)
IDU history			
No	1667 (99.3)	131 (7.9)	1
Yes	12 (0.7)	4 (33.3)	5.86 (1.74 to 19.73)
Ever engaged in MSM activities†			
No	1057 (98.5)	61 (5.8)	1
Yes	16 (1.5)	1 (6.3)	1.09 (0.14 to 8.38)

*During the last sex with non-primary partner, did you use a condom?

†Analysis restricted to men only.

IDU, injecting drug use; MSM, men who have sex with men.

education; not living in Site D (OR 0.36, 95% CI 0.18 to 0.72) compared to living in the other cities; ever engaged in commercial sex (OR 1.81, -1.16 to 2.94) compared to never having engaged in commercial sex; and history of intravenous drug use (OR 5.86, 95% CI 1.74 to 19.73). Middle-born sibling position was also associated with a higher percentage of reported STI history (44.7% compared to 34.7%, $p<0.001$). Being middle-born was not associated with reporting homosexual behaviours ($p=0.4$).

The multivariate model predicting syphilis among male clinic patients ($n=1163$) included higher education, not living in Site D and ever engaging in commercial sex (table 3). Sibling position, age, marital status and injecting drug use (IDU) history were not in the final model. Middle-born sibling position was significantly related to ever engaging in commercial sex. The multivariate model predicting syphilis among female clinic patients ($n=626$) included unmarried, higher education and not living in Site D (table 4).

DISCUSSION

The resurgent syphilis epidemic in China forces broader thinking and action about this ancient pathogen. Changing family structure, perhaps through its social and economic effects on individuals, may have important implications for the expansion of syphilis.⁶ To our knowledge, this is the first study to examine the sexual

Table 3 Multivariate model predicting syphilis among all male clinic patients ($n=1163$)

Predictor	Adjusted OR (95% CI)
Sibling position	
First-born	1
Middle-born	1.58 (0.77 to 3.28)
Final-born	0.99 (0.50 to 1.96)
Age	
>40 years	1
≤40 years	0.59 (0.32 to 1.09)
Marital status	
Married	1
Unmarried	2.13 (0.89 to 2.84)
Education	
≤High school	1
>High school	1.59 (1.20 to 3.47)
Site	
Site A	1
Site B	0.90 (0.43 to 1.88)
Site C	0.69 (0.35 to 1.37)
Site D	0.21 (.06 to 0.73)
Ever engaged in commercial sex	
No	1
Yes	1.90 (1.04 to 3.50)
IDU history	
No	1
Yes	4.44 (0.05 to 39.98)

IDU, injecting drug use.

Table 4 Multivariate model predicting syphilis among all female clinic patients ($n=626$)

Predictor	Adjusted OR (95% CI)
Sibling position	
First-born	1
Middle-born	1.21 (0.63 to 2.32)
Final-born	0.90 (0.47 to 1.73)
Age	
>40-years	1
≤40-years	1.17 (0.57 to 2.43)
Marital status	
Married	1
Unmarried	2.62 (1.38 to 4.96)
Education	
≤High school	1
>High school	1.77 (1.01 to 3.12)
Site	
Site A	1
Site B	0.46 (0.21 to 1.00)
Site C	0.78 (0.38 to 1.61)
Site D	0.22 (0.09 to 0.56)
Ever engaged in commercial sex	
No	1
Yes	0.97 (0.40 to 2.37)

risk behaviours of adults according to sibling position. Easing of China's One Child Policy has already resulted in greater multisibling families and this trend is likely to increase over time.⁹ Both sexual preference and socio-economic status are known to vary according to sibling position and may contribute to differential sexual risk behaviours. Our finding that Site D had a lower burden of syphilis among men and women is striking, but the low number of sites ($n=4$) precluded a more formal analysis of site-level characteristics associated with syphilis infection. More comprehensive STI control services in Site D prior to this research project may have contributed to this trend.

Our results suggest that middle-born men have a higher risk of STI history and a greater risk of purchasing sex. The relationship between middle-born and history of syphilis was independent of self-reported homosexuality, income and education levels. However, middle-born sibling position was not in the final multivariate model because it was associated with ever having had commercial sex. Adolescent research from the USA has suggested that later sibling positions have increased sexual risk behaviours.¹⁷⁻¹⁹ This effect in adolescents is thought to be related to the influence of having sexually active older siblings who influence their younger brothers and sisters^{28 29} or relatively less psychological support from parents.³⁰ The trend of middle-born individuals having a higher risk of STIs and purchasing sex could be related to the persistence of the effect found in adolescence. Psychological attributes associated with individuals who are middle-born (eg, more relaxed attitude)²⁶ may also establish a context for increased sexual risk taking.

Our finding that more highly educated women are more likely to have syphilis infection contrasts with studies of other STIs among Chinese women. For example, a population-representative study of *Chlamydia* in China found that women who had less education were more likely to have *Chlamydia*²⁴ and this trend has been found in a number of other studies.^{31–33} The observed association between higher education and syphilis among women in our study, however, is consistent with the previous research that demonstrated greater syphilis risk among Chinese men with more education.^{7 24} Groups of high-income men in China often incorporate visits to sex venues as part of business banquets, using such opportunities to establish, maintain and extend social relationships critical for work and thus potentially increasing the risk of STI transmission to their wives.³⁴

There are several important limitations in this study. First, our study was not a population-based sample and so generalisations should be made with caution. Second, our study was only cross-sectional and so the cumulative sexual risk could not be captured within a single syphilis measurement. Third, this study only examined public STI clinics, but did not explore private clinics where a subset of high-risk men probably seeks sexual health services. However, public clinics are the most common sources of clinical STI service²⁴ and the only sector with the physician, laboratory and nurse capacity to undertake research.

Major family and social changes underway in China are likely to influence sexual risk behaviours and the extent to which unsafe commercial sex becomes normalised. Social determinants may have an impact at multiple levels—family, neighborhood, city and higher levels of organisation. Better understanding the social context of sexually transmitted diseases (STDs), such as family structures, can help us to inform structural interventions focused on improving sexual health. For example, the finding that younger male siblings have a higher sexual risk could be used to target younger male siblings in STD control social marketing campaigns. A tailored approach to reaching subsets of high-risk groups has been effective in other settings.^{35 36} Further research on the social determinants of sexual health is needed.

Contributors JDT, LY and BY conceived and designed the study. JDT and DY performed the analysis. LY, BY, JDT and AAA analysed the data. AAA and BY have contributed to analysis tools. JDT, DY, LY, BY and AAA wrote the paper. All authors have read and approved the final manuscript.

Funding This work was supported by an NIH Fogarty K01 Award (US NIH 1K01TW008200–01A1), the UNC Fogarty AIDS International Research and Training Program (NIH FIC D43 TW01039), the WHO Rapid Syphilis Test Project (UNICEF/UNDP/World Bank/WHO A70577), the Harvard Institute for Global Health, and a Burroughs Wellcome Fund/American Society of Tropical Medicine and Hygiene Wellcome Postdoctoral Fellowship in Tropical Infectious Diseases. The funders had no role in the study design, data collection and analysis, decision to publish or preparation of the manuscript.

Competing interests None.

Ethics approval All participants received verbal informed consent prior to participation. Verbal consent was used because of the minimal risk associated with participating in this study and documented by the research assistant who enrolled the patient in the study. This research protocol and consent procedure

was approved by the Medical Ethics Committee of Chinese Academy of Medical Sciences Institute of Dermatology (Nanjing, China), the University of North Carolina Institutional Review Board (Chapel Hill, North Carolina, USA), and the Partners Committee on Human Subjects Research (Boston, Massachusetts, USA).

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement Deidentified data set from this study are available on request on the corresponding author.

REFERENCES

- Chen ZQ, Zhang GC, Gong XD, *et al.* Syphilis in China: results of a national surveillance programme. *Lancet* 2007;369:132–8.
- Tucker JD, Chen XS, Peeling RW. Syphilis and social upheaval in China. *N Engl J Med* 2010;362:1658–61.
- Tucker JD, Cohen MS. China's syphilis epidemic: epidemiology, proximate determinants of spread, and control responses. *Curr Opin Infect Dis* 2011;24:50–5.
- Shahmanesh M, Cowan F, Wayal S, *et al.* The burden and determinants of HIV and sexually transmitted infections in a population-based sample of female sex workers in Goa, India. *Sex Transm Infect* 2009;85:50–9.
- Lopez-De Fede A, Stewart JE, Hardin JW, *et al.* Spatial visualization of multivariate datasets: an analysis of STD and HIV/AIDS diagnosis rates and socioeconomic context using ring maps. *Public Health Rep* 2011;126(Suppl 3):115–26.
- Tucker JD, Henderson GE, Wang TF, *et al.* Surplus men, sex work, and the spread of HIV in China. *AIDS* 2005;19:539–47.
- Tan NX, Messina JP, Yang LG, *et al.* A Spatial analysis of county-level variation in syphilis and gonorrhea in Guangdong province, China. *PLoS ONE* 2011;6:e19648.
- Tucker JD, Poston D, Qiang R. *Gender policy and HIV in China: catalyzing policy change*. 1st edn. New York: Springer, 2009.
- Wang C. History of the Chinese Family Planning program: 1970–2010. *Contraception* 2011;85:563–9.
- Downey DB. Number of siblings and intellectual development. The resource dilution explanation. *Am Psychol* 2001;56:497–504.
- Zajonc RB. Family configuration and intelligence. *Science* 1976;192:227–36.
- Steelman LC, Powell B, Werum R, *et al.* Reconsidering the effects of sibling configuration: recent advances and challenges. *Annu Rev Sociol* 2002;28:243–69.
- Keister LA. Sharing the wealth: the effect of siblings on adults' wealth ownership. *Demography* 2003;40:521–42.
- Keister LA, Keister LA. Race, family structure, and wealth: the effect of childhood family on adult asset ownership. *Sociol Perspect* 2004;47:161–87.
- Nicolaou NC, Simpson A, Lowe LA, *et al.* Day-care attendance, position in sibship, and early childhood wheezing: a population-based birth cohort study. *J Allergy Clin Immunol* 2008;122:500–6 e5.
- Lawson DW, Mace R. Sibling configuration and childhood growth in contemporary British families. *Int J Epidemiol* 2008;37:1408–21.
- Rodgers JL, Rowe DC. Influence of siblings on adolescent sexual behavior. *Dev Psychol* 1988;24:722–8.
- Reiss IL. *The social context of premarital sexual permissiveness*. New York: Holt, Rinehart & Winston, 1967.
- Rodgers JL. Family configuration and adolescent sexual behavior. *Popul Environ* 1983;6:73–83.
- Bogaert AF. Biological versus nonbiological older brothers and men's sexual orientation. *Proc Natl Acad Sci USA* 2006;103:10771–4.
- Schwartz G, Kim RM, Kolundzija AB, *et al.* Biodemographic and physical correlates of sexual orientation in men. *Arch Sex Behav* 2010;39:93–109.
- Puts DA, Jordan CL, Breedlove SM. O brother, where art thou? The fraternal birth-order effect on male sexual orientation. *Proc Natl Acad Sci USA* 2006;103:10531–2.
- Tucker JD, Yang LG, Yang B, *et al.* A twin response to twin epidemics: integrated HIV/syphilis testing at STI clinics in South China. *J Acquir Immune Defic Syndr* 2011;57:e106–11.
- Parish WL, Laumann EO, Cohen MS, *et al.* Population-based study of chlamydial infection in China: a hidden epidemic. *JAMA* 2003;289:1265–73.
- Li L, Wu Z, Rotheram-Borus MJ, *et al.* Visiting entertainment venues and sexual health in China. *Arch Sex Behav* 2009;38:814–20.
- Sulloway FJ. *Born to rebel: birth order, family dynamics, and creative lives*. 1st Vintage Books edn. New York: Vintage Books, 1997.
- Toman W. *Family constellation; theory and practice of a psychological game*. Drawings [by] Miné Okubo. New York: Springer Pub. Co., 1961.

28. Miller BC, Benson B, Galbraith KA. Family relationships and adolescent pregnancy risk: a research synthesis. *Dev Rev* 2001;21:1–38.
29. Rwege M. Sexual risk behaviors among young people in Bamenda, Cameroon. *Int Family Planning Perspect* 2000;26:118–23.
30. Terada T, Kasai M, Asano K. Psychological support for junior high school students: sibling order and sex. *Psychol Rep* 2006;99:179–90.
31. Li Y, Detels R, Lin P, *et al.* Difference in risk behaviors and STD prevalence between street-based and establishment-based FSWs in Guangdong Province, China. *AIDS Behavior* 2012;16:943–51.
32. Lu F, Jia Y, Sun X, *et al.* Prevalence of HIV infection and predictors for syphilis infection among female sex workers in southern China. *Southeast Asian J Trop Med Publ Health* 2009;40:263–72.
33. Lu F, Jia Y, Bin S, *et al.* Predictors for casual sex and/or infection among sexually transmitted disease clinic attendees in China. *Int J STD AIDS* 2009;20:241–8.
34. Uretsky E. 'Mobile men with money': the socio-cultural and politico-economic context of 'high-risk' behaviour among wealthy businessmen and government officials in urban China. *Cult Health Sex* 2008;10:801–14.
35. Bellis JM, Grimley DM, Alexander LR. Feasibility of a tailored intervention targeting STD-related behaviors. *Am J Health Behav* 2002;26:378–85.
36. Herbst JH, Sherba RT, Crepaz N, *et al.* A meta-analytic review of HIV behavioral interventions for reducing sexual risk behavior of men who have sex with men. *J Acquir Immune Defic Syndr* 2005;39:228–41.